

VOL. V, PP. 49-58, PL. 20

April, 29, 1893

THE
NATIONAL GEOGRAPHIC MAGAZINE

RAINFALL TYPES

OF THE

UNITED STATES

ANNUAL REPORT BY VICE-PRESIDENT
GENERAL A. W. GREELY



WASHINGTON

PUBLISHED BY THE NATIONAL GEOGRAPHIC SOCIETY

Price 25 cents

THE
NATIONAL GEOGRAPHIC MAGAZINE

RAINFALL TYPES OF THE UNITED STATES

ANNUAL REPORT BY VICE-PRESIDENT

GENERAL A. W. GREELY

(Presented before the Society January 15, 1903)

In carrying out the announced policy of the National Geographic Society with regard to annual contributions from its vice-presidents in their respective domains of geographic science, it has seemed advisable for the vice-president of the "Geography of the Air" to place before the Society this year a special paper.

The subject selected is the typical distribution of rainfall in the United States and contiguous territory, and an attempt has been made to treat the subject in such a manner that it may be a permanent contribution to the physical geography of the United States. It goes without saying that a paper covering twenty minutes' reading cannot go much into detail, but it is hoped that the treatment, while general, is yet such as to give definite and clear ideas on the subject treated.

This paper does not consider the distribution of rain from the standpoint of the mean annual precipitation, does not dwell on the variability or unequal amounts in consecutive years, aims to discuss the distribution from the standpoint of varying elevations, and is silent on the question of distribution with reference to frequency or absence of excessive rains of periodic or un-

dential occurrence. It confines itself to a question of great and sometimes vital importance, to the characteristic distribution of precipitation throughout the year, and, as is believed, presents a successful analysis of the average fluctuations from month to month, so that for the first time a satisfactory presentation is possible of all the simple rainfall types and of most of the composite types which obtain over the broad expanse of the inhabited portions of North America.

The necessity of careful and scientific study of climatic conditions in connection with prospective enterprises, whether pertaining to agriculture, commerce, navigation, or to special industries, has become obvious the past few years through the spur of competition. Among such conditions, that of rainfall distribution throughout the year is one of the most important. With relation to agriculture, it is essential to know whether precipitation comes at such seasons as to be a benefit or a detriment to the proposed crop. In the initiation of irrigation enterprises not only are the questions of guarding against excessive and torrential rains on one hand and of living over temporary droughts on the other of importance, but, further, whether the most copious precipitation occurs in such months as to afford water at seasons of periods, or the rain comes at such times that it must be stored for many months with consequent loss from seepage and evaporation. Similarly, this question of distribution of rain throughout the year affects most potently other business interests of importance.

That these questions are of current and practical value is evident to every thoughtful man, and that their earlier elucidation and the publication of results would have been an extended benefit cannot be questioned. Take agriculture, for instance, which in eastern Colorado is pursued under difficult conditions wherever irrigation is impracticable. Failure of crops very frequently resulted until observation showed that a scanty rainfall in June is the rule in that section, and that by planting at a certain season the injurious effects of the June drought could be mitigated.

Nor is the necessity of a definite and accurate determination of the typical forms of annual precipitation in the eastern part of the United States less obvious, since the latest text-book on meteorology in use in the United States, that of Loomis, contains the statement that "Throughout most of the United States wet

of the Rocky mountains the rain is pretty equally distributed through the different months of the year, but the rain of summer is *everywhere* somewhat greater than that of winter, including melted snow.²

In reality the whole section of country, about 200,000 square miles in extent, dominated by the Tennessee type of rainfall experiences a larger precipitation in winter than in summer, the excess averaging in northern Alabama and southern Kentucky about 10 per cent, in western Georgia and in Tennessee over 20 per cent, and in southeastern Arkansas and northern Louisiana from 40 to 50 per cent (plate 20).

I have pointed out elsewhere the vital importance of a favorable distribution of rainfall to certain sections of the country, where this favoring type of precipitation has proved to be one of the great bases on which rests the national prosperity of this great republic. Allusion is made to the great grain-producing sections throughout the water-shed of the upper Mississippi, the Missouri, the Red river of the North, comprising the Dakotas, Minnesota, Kansas, Nebraska, Iowa, Missouri, Wisconsin and Illinois. Over the greater part of this immense area the annual rainfall is very materially less than that of the regions to the eastward or southward, but, most fortunately for the country, about three-fifths of the rainfall for the entire year occurs opportunely through the period when it is most beneficial to crops, from April to July, inclusive. A less favorable type of rainfall, the Mexican or the Saint Lawrence, for example, would render growing of grain unprofitable throughout the whole of this favored region.

It remains to briefly indicate the few types of simple rainfall with the localities to which they refer, and to the composite types occurring through the overlapping and interference of simple types.

Composite types must prevail where two simple types are not separated by high mountain ranges, and thus gradually shade or merge into each other. One dividing line, the Rocky mountain range, separates by its crest, if not absolutely, yet quite sharply and definitely, the Missouri type in Montana and Wyoming from the Pacific type in Idaho and Washington.

The term *simple* has been applied to those rainfall types which can be graphically expressed by a curve with a single bend or inflection. The average monthly amounts pass from the single

maximum to the single minimum through uninterruptedly diminishing quantities, and thence rise with unbroken increase to the maximum. The *composite* types are those in which the graphic expression would be shown by two inflections, from a primary maximum through the minimum to a secondary maximum and secondary minimum.

In general terms it may be said that each simple type of rainfall in the United States appertains to a single body of water for its resulting precipitation; thus the Pacific type comes directly from the Pacific ocean, the Mexican type from the gulf of California, the Tennessee type from the gulf of Mexico, and the Atlantic type from the Atlantic ocean. In the Missouri type, however, two sources are evident—primarily the gulf of Mexico, and secondarily, and to a much larger degree than has been usually advanced, Hudson bay and the chain of great American lakes.

In treating the fluctuations of rainfall throughout the year it is evident that the unequal lengths of the different months affect somewhat the accuracy of direct inter-comparisons of normal monthly rainfalls. There fell under my observation lately a curve showing such inter-comparisons which proved misleading, as it showed a decrease of rain from January to February and an increase from February to March, when in reality, as shown by the average amount daily for each month, the rainfall became more copious from January to February and from February to March.

In this discussion the rule has been followed of obtaining the normal daily rainfall by dividing the normal yearly rainfall by 365.25. In like manner the average daily rainfall of February has been found by using 28.25 as a divisor, and the longest months by using 31. In this paper, for the sake of brevity and in order to avoid repetition, it is to be explained that the term "normal daily rainfall" is applied to the mean determined from the annual precipitation, and that the terms "January rainfall, March rainfall," etc, unless otherwise explicitly stated, mean the average daily amount determined for the month in question by the methods above indicated.

The best defined type of rainfall within the limits of the United States is that which dominates the Pacific coast region; hence the specific name "Pacific" herein applied. In general terms it may be said to dominate British Columbia, Washington,

Idaho, Oregon, California, Nevada and western Utah; in other words, the great interior basin and the entire Pacific watershed from British Columbia to lower California, excluding the section draining into the gulf of California. The characteristic features are very heavy precipitation during midwinter, and an almost total absence of rain during the late summer.

The infrequency of summer rain is marked in British Columbia, and thence southward it becomes steadily more pronounced, passing through the gradations of a single rainless month in northern California, then two and three to its culmination of four rainless months in a considerable part of southern California and western Nevada. There is a tendency in the upper half of the San Joaquin valley and thence southward into the western part of San Diego county for rain to cease about a month earlier and to remain absent a month later than over the rest of the Pacific coast region, the dry season being from June to September, inclusive, and being usually unbroken even by a passing shower.

Eastern Nevada appears to share freedom from rain during July, but the autumnal rains appear in September or earlier, under the influence in the southern part of that state of the Mexican type projecting northward. The marked tendency of the winter rains to continue into spring is evident in Washington, whence it shades with diminishing persistency to northern California and northwestern Nevada.

It may be remarked that in the Pacific coast regions the amounts of rain vary very greatly, according to the topography of the section and the distance from the ocean; so that the interior depressions, such as the Sacramento, San Joaquin and other valleys, particularly those parallel with the coast, have a scantier rainfall than either the coast itself or the Sierra Nevada and other mountain ranges to the eastward.

These variations in the total rainfall do not, however, affect the distribution throughout the year, which is typically Pacific throughout the whole region.

As might be expected where the rainfall is very small, a single month of excessive precipitation occasionally increases the rainfall so as to be misleading. For instance, it is apparent from inspection that the greatest normal precipitation is that of December at both San Diego, California and Hallock, Nevada; yet excessive rainfalls of 9.65 inches in February, 1884, at the former

place, and 4.00 inches in February, 1870, at the latter, throw the February daily precipitation slightly above that of December. Of the following examples of the Pacific type, five are drawn from the interior, viz, Spokane, Washington, records of 12 years; Delano, California, 15 years; Boise City, Idaho, 22 years; Promontory, Utah, 21 years; Hall's Fork, Nevada, 21 years; and three from coast stations, viz, Astoria, Oregon, 29 years; San Diego and San Francisco, California, each 41 years.

Normal daily Rainfall and monthly Departures therefrom.

(Values are in fractions of an inch.)

STATIONS.

Spokane, Oregon, normal daily rainfall for 12 years, 1870.	San Francisco, Cal., 41 years and daily rainfall for 11 years, 1870.	San Diego, Cal., normal daily rainfall for 41 years, 1870.	Delano, Cal., 15 years, normal daily rainfall for 15 years, 1870.	Boise City, Idaho, 22 years, normal daily rainfall for 11 years, 1870.	Promontory, Utah, 21 years, normal daily rainfall for 11 years, 1870.	Hall's Fork, Nevada, 21 years, normal daily rainfall for 11 years, 1870.	Astoria, Oregon, 29 years, normal daily rainfall for 11 years, 1870.	San Diego and San Francisco, Cal., 41 years, normal daily rainfall for 11 years, 1870.
--	--	--	---	--	---	--	--	--

DEPARTURES.

January	.28	.30	.307	.30	.304	.305	.294	.30
February	.304	.300	.301	.309	.300	.304	.309	.300
March	.310	.300	.303	.302	.309	.303	.302	.300
April	-.302	-.302	-.303	.303	-.300	.304	.300	.300
May	-.302	-.304	-.300	.300	-.303	.304	.300	.300
June	-.311	-.305	-.307	-.307	.300	-.304	-.300	-.300
July	-.310	-.306	-.307	-.307	-.300	-.303	-.304	-.303
August	-.310	-.306	-.307	-.307	-.300	-.304	-.304	-.300
September	-.309	-.301	-.307	-.311	-.300	-.300	-.304	-.300
October	-.300	-.300	-.300	-.307	.300	-.303	-.300	-.300
November	.311	-.300	-.300	.300	-.300	.303	-.300	-.300
December	.311	.310	-.301	.301	.303	.300	.303	.300

Another simple type of rainfall is that which in a previous paper I designated as the "Treme-Pecos," from the fact that it dominates extreme western Texas beyond the Pecos river. On further investigation it proved to prevail in the province of

November 1904, and December 1905. Snow is not of sufficient importance in Texas, and the western of the two is an arched or pointed to a conical type of rain, coming from a storm mass of the Mexican type from southward and the Missouri type from the eastward.

Colorado has the conical type of rain, common in winter or April and the principal maximum in January, while the conical type maximum occurs in April or May and is more a type maximum in June. It is hardly necessary to state that the heavy rains belong to the conical type common to the entire Mexican or the conical Missouri type of the northern rivers, and not of a position between and generally indicated on the map to be somewhat.

There is a great variety of rainfall, but that one, not being from the same source, is not the same as the conical and from different heights by the Pacific, Mexican, and even the Missouri type, the first rain of being most potent, especially in the west and extreme northern part of the territory.

The "Missouri" type of rainfall is the most regular, the United States, which is from the west and over which it extends and extends the extremely heavy rain, and is the most common type dominates the water sheds of the Appalachian, Missouri, upper Mississippi rivers and of Lake Ontario and Michigan, as well as over the Ohio and the greater part of northern Texas. It is covering Montana, Idaho, Kansas, Minnesota, Nebraska, Kansas, Iowa, Missouri, Oklahoma, Wisconsin and Illinois, together with parts of Arkansas, Texas, Michigan, Indiana and Ohio territory.

The Missouri type is a very regular winter precipitation, falling in the spring in early summer by the middle of the rainy season. The amount of water covered by this type is so large that certain slight modifications are to be made, particularly in the case of the Colorado rain, which is a rain, but not, yet along the mountain slope of the Rocky Mountains.

May or fall is somewhat greater than that of the following month. Again, while January is usually the month of the precipitation, yet in some localities the rain may have a tendency to occur in October and to others to be very well in the

Examples of the Missouri type have been preserved from 1840 to 1880, 1880 to 1890, 1890 to 1900, 1900 to 1910, and 1910 to 1920.

Leota, 30; Hastings, North Dakota, 18; Fort Ransom, South Dakota, 32; Fort Tule & Mansboro, 27; Emporia, Kansas, 30; Mount Vernon, Missouri, 33; Fort Shaw, Montana, 19; Omaha, Nebraska, 24; and Madison, Wisconsin, 24 years.

Amount of rainfall in 1911 and 1912 at each station

(Total amount of rainfall in 1911 and 1912)

Station	1911		1912		Total		Average		Percentage	
	Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage	Amount	Percentage
Leota	30.0	100	28.0	93	58.0	193	29.0	96	29.0	96
Hastings	18.0	100	17.0	94	35.0	194	17.5	97	17.5	97
Fort Ransom	32.0	100	30.0	94	62.0	194	31.0	97	31.0	97
Fort Tule & Mansboro	27.0	100	25.0	93	52.0	193	26.0	96	26.0	96
Emporia	30.0	100	28.0	93	58.0	193	29.0	96	29.0	96
Mount Vernon	33.0	100	31.0	94	64.0	194	32.0	97	32.0	97
Fort Shaw	19.0	100	18.0	95	37.0	195	18.5	97	18.5	97
Omaha	24.0	100	22.0	92	46.0	192	23.0	96	23.0	96
Madison	24.0	100	22.0	92	46.0	192	23.0	96	23.0	96

The general character of the Missouri type is perhaps best indicated by the rainfall of Nebraska, this state being typical as regards this type. In Nebraska only about 6 per cent of the yearly precipitation occurs from December to February, the rest. In April, however, the percentage of the entire annual rainfall is 11; in May 17, in June 19, or 1 July 19, making about 60 per cent for these four months. In other words, three-fifths of the yearly rainfall occurs most opportunely during the period when it is most beneficial to the growing crops. It is well known that the annual rainfall is usually, year after year, about 30 to 40 in.

54. *Less Abundant*—*Less-fall Type of the Lesser Noddy*

Western No. noddys recover a distance from about 25 April to July, including a longer period of incubation than the anterior portions of the colony, from Maine to Virginia and western Nebraska, since it is only a slightly lower average. With a further protraction of the year from 1919 to the world wars, and westward in Nebraska, yet the same general type of distribution prevails.

In Missouri, by a distance of 100 miles west of the Virginia type, it is somewhat less, the Tennessee type to the south and west, and Tennessee to the east and east.

The "Tennessee" type, which is not generally very abundant, is well marked, the migration is delayed, and the start of winter of the first of spring, while the minimum is so undisturbed.

The Tennessee type of birds over Tennessee, Alabama, Mississippi, and north to the Gulf, western Georgia, and even to the mountains of the coast, to the coast of Louisiana. In some of the more western Kentucky and Tennessee, and to the parts of Arkansas, the parts of February and the middle of March, the migration of the birds is not so well marked as in the east and south. The birds of the Tennessee type are slightly more abundant in April than in March.

It is also to be noted that the migration is to be a tendency toward the south, and in some cases to August or September rather than October, in which month the minimum occurs for the greater portion of the area.

Consequently, while the Tennessee type is abundant in the Mississippi, Tennessee, and Arkansas, the Tennessee type of migration is not.

them for life now on the grounds of the very spring being very low and rough. To remedy this, it may be said to be well marked to remove channels at the coast toward August as the month of maximum rainfall. When the spring is low as far as the Atlantic ocean, a light sandy water is a good thing. It is also a type of the form of ground and ground. The sea rolls to July, while the water is in the Gulf, with a current in the November from Florida, western New York, and the Atlantic to October along the coast of the Atlantic range and the Gulf of Mexico as shown in the figure by the two sides of Atlantic Ocean, and the Atlantic Ocean.

The effect of water on the growth of *Lawsonia* is represented by the following equation for Troy, New York, in a maximum of February 15, March 15, even as far as the addition of experience a very slight influence.

As a result, the \mathcal{H}_2 norm of the closed-loop system is bounded by

4. \mathbb{R}^n 上的函数 f 称为 n 次齐次函数, 如果 $f(x) = f(\lambda x)$ 对任意 $\lambda \in \mathbb{R}$ 成立.

17. 17000000

in New England the Atlantic type is constantly modified and the character of the distribution, with a little determination, is recognizable, owing to the slight variations, in the distribution, by the character of the Saint Lawrence valley. In consequence we find in New England a composite type in which the Atlantic character of the Atlantic type is generally present, and a November primary minimum, varying in some localities, is also present in some of the regions. The Atlantic November minimum is replaced by a June primary minimum which is secondary in minimum in some localities in September and March in April.

Seasonality in North and Southwestern Canada

1870-1871



The distribution of precipitation in the Saint Lawrence valley and north of composite type, probably results from its position, to be considered separately as the "Saint Lawrence" type. The

that market is not sensitive to proposals of a change in the amount of the supply being offered. The amount of the supply is determined by the market, and a farmer would be selling the same amount of wheat whether he had a contract to sell it at a fixed price in October or November and for a guaranteed amount in June or August. The story has been told too many times before to need a retelling. November is the most remarkable time now for the fact that the price of wheat is not a price for wheat, but a price for wheat for the month of central New York.

But, in the payment of the salary to the school, and for the use of the same, the Government, and of the authorized society of the school, of the said, is with the City of New York, and that the same is a representation of the same, in April of 1850, 1850.

Medford, Quebec, Lake Umbagog, Saguenay, and Parry Sound, as well as throughout the province of New Brunswick. It is not possible to select an out-crop into a full type of New England and New Brunswick as well as across the whole of part of the Atlantic section of Atlantic Canada, the New Brunswick section. The out-crop is in the topographic and geological, and the Atlantic section of section by the out-crop, as the out-crop is these out-crop are reversed in order of deposit.

There may possibly be added a considerable number of specimens of the numerous species of the gulf of Mexico. We were two years in the rain forest in September and in the dry forest in the early spring. Western Florida and the Texas woods are the dry forest, and the rest is rain forest. The rainfall is yearly from 40 to 60 inches. The years are 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 256

It is not within the scope of this paper to discuss the special cases which are due to special types of particle distribution in North America. It may be said, however, that there is a strong possibility that the maximum particle processes of the type considered here had important consequences in the development of large-scale structure over North America and the surrounding waters, if conditions are favorable for the onset of high-latitude magnetic convection and the ensuing winds, and for favorable conditions for precipitation, even leading to significant secondary

